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**NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA**

(An Autonomous Institute Affiliated to AKTU, Lucknow)

**B.Tech**

**SEM: III - THEORY EXAMINATION (2024 - 2025)**

**Subject: Data Structures**

**Time: 3 Hours**

**Max. Marks: 100**

**General Instructions:**

**IMP:** Verify that you have received the question paper with the correct course, code, branch etc.

1. This Question paper comprises of **three Sections -A, B, & C**. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.

2. Maximum marks for each question are indicated on right -hand side of each question.

3. Illustrate your answers with neat sketches wherever necessary.

4. Assume suitable data if necessary.

5. Preferably, write the answers in sequential order.

6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

**SECTION-A**

20

1. Attempt all parts:-

- 1-a. Select the worst case time complexity of quicksort is \_\_\_\_\_. (CO1, K1) 1
- (a)  $O(n)$
- (b)  $O(n^2)$
- (c)  $O(n \lg n)$
- (d)  $O(\lg n)$
- 1-b. Select the best case and worst case complexity for binary search. (CO1,K1) 1
- (a)  $O(n \log n)$ ,  $O(n)$
- (b)  $O(\log n)$ ,  $O(1)$
- (c)  $O(n)$ ,  $O(O(n^2))$
- (d)  $O(1)$ ,  $O(n)$
- 1-c. Process of removing an element from stack is called \_\_\_\_\_(CO1,K1) 1
- (a) Create
- (b) Push
- (c) Evaluation
- (d) Pop
- 1-d. In a stack, if a user tries to remove an element from an empty stack it is called \_\_\_\_\_ (CO2,K1) 1
- (a) Underflow
- (b) Empty collection

- (c) Overflow
- (d) Garbage Collection
- 1-e. Select the following operations that is performed more efficiently by doubly linked list than by singly linked list. (CO3, K2) 1
- (a) Deleting a node whose location is given
- (b) Searching of an unsorted list for a given item
- (c) Inverting a node after the node with given location
- (d) Traversing a list to process each node
- 1-f. Consider an implementation of unsorted singly linked list. Suppose it has its representation with a head and tail pointer. Given the representation, which of the following operation can be implemented in  $O(1)$  time. (CO3, K2) 1
- I) Insertion at the front of the linked list
- II) Insertion at the end of the linked list
- III) Deletion of the front node of the linked list
- IV) Deletion of the last node of the linked list
- (a) I and II
- (b) I and III
- (c) I, II and III
- (d) I, II and IV
- 1-g. In a full binary tree if number of internal nodes is I, then number of nodes N are? (CO4, K2) 1
- (a)  $N = 2 * I$
- (b)  $N = I + 1$
- (c)  $N = I - 1$
- (d)  $N = 2 * I + 1$
- 1-h. Select the following is not an advantage of trees. (CO4, K1) 1
- (a) Hierarchical structure
- (b) Faster search
- (c) Router algorithms
- (d) Undo/Redo operations in a notepad
- 1-i. Select the correct option, if the number of edges present in a complete graph having n vertices. (CO5, K1) 1
- (a)  $(n * (n + 1)) / 2$
- (b)  $(n * (n - 1)) / 2$
- (c) n
- (d) Information given is insufficient
- 1-j. For a given graph G having v vertices and e edges which is connected and has no cycles, which of the following statements is true? (CO5, K1) 1

- (a)  $v=e$
- (b)  $v = e+1$
- (c)  $v + 1 = e$
- (d)  $v = e-1$ .

2. Attempt all parts:-

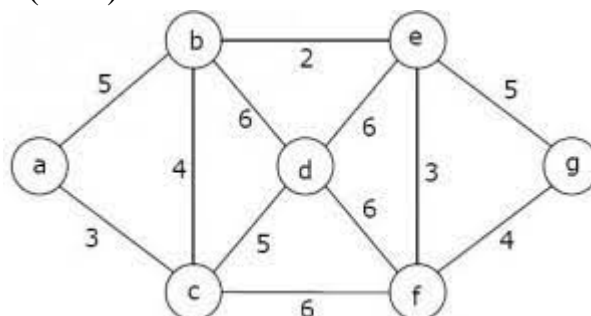
- 2.a. A matrix  $B[10][20]$  is stored in the memory with each element requiring 2 bytes of storage. If the base address at  $B[2][1]$  is 2140, find the address of  $B[5][4]$  when the matrix is stored in column major wise. (CO1,K2). 2
- 2.b. The prefix form of  $B - A / (D * E ^ C)$  is? (CO2,K2) 2
- 2.c. Describe the difference between singly linked list to circular linked list. (CO3,K1). 2
- 2.d. Calculate the null nodes in a binary tree with 20 nodes. (CO4,K2). 2
- 2.e. List the advantage of link list over arrays. (CO5, K2) 2

### **SECTION-B**

30

3. Answer any five of the following:-

- 3-a. Explain the concept of radix sort. Write the algorithm for it.(CO1, K2) 6
- 3-b. How binary search is different from linear search? Apply binary search to find item 40 in the sorted list: 11, 22, 30, 33, 40, 44, 55, 60, 66, 77, 80, 88, 99. (CO1) 6
- 3-c. Explain the concepts of stacks and queues in data structures, including their key operations and provide two examples of each in real-world applications. (CO2, K1) 6
- 3-d. Write down the algorithm for solving Towers of Hanoi problem? Demonstrate time complexity in best case. (CO2, K3) 6
- 3.e. Write a program in Python, with separate user defined functions to perform the following operations on Stack 'ITEM'. 6
  - (a) - Push the name of the item in the stack 'ITEM'
  - (b) - Display the latest added element in the stack 'ITEM' (CO3,K3)
- 3.f. Construction of the AVL Tree for the given Sequence 21, 26, 30, 9, 4, 14, 28, 18,15,10, 2, 3, 7. (CO4,K3) 6
- 3.g. Construct the minimum spanning tree (MST) for the given graph using Kruskal's Algorithm. (CO5) 6



## SECTION-C

50

4. Answer any one of the following:-

- 4-a. Write a program to implement merge sort. Trace the working of the algorithm on the following input: 14, -44, 16, 4, 15, -17, 5, 42, 78. (CO1, K3) 10
- 4-b. Define Bubble Sort. Write a python program for Bubble sort and find its complexity. (CO1,K3) 10

5. Answer any one of the following:-

- 5-a. **Write the postfix and prefix forms of the expression using stack. (CO2, K3)**  
 $A+B*(C-D)/(P-R)$  10
- 5-b. Write the advantages of priority queue over simple queue. Also write following routine of priority queue. 1)insert 2) delete 3) display (CO2,K3) 10

6. Answer any one of the following:-

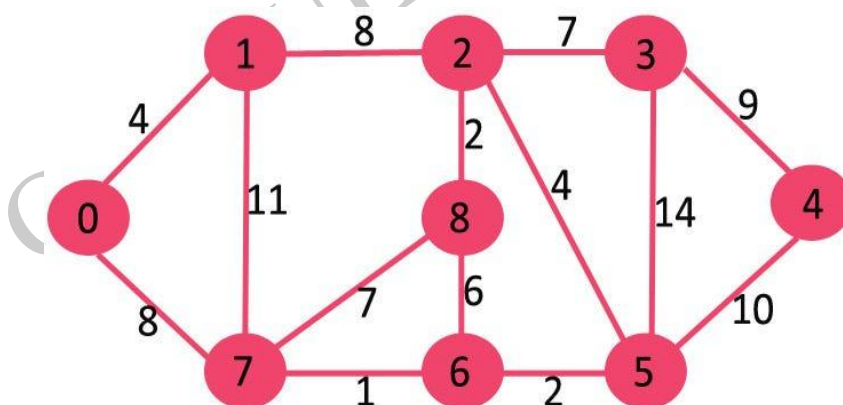
- 6-a. Explain the concept of double ended queue. Write the algorithm for insertion and deletion in double ended queue. (CO2, K3) 10
- 6-b. Show the detailed contents of the stack for the evaluation of postfix expression: 6 2 3 + - 3 8 2 / + \* 2 & 3 +. (CO3,K3) 10

7. Answer any one of the following:-

- 7-a. Write the algorithm/program to count numbers of nodes in a Binary tree. Also enlist the difference between full binary tree and complete binary tree. (CO4,K3) 10
- 7-b. Write the characteristics of a B-Tree of order m. Create B-Tree of order 5 from the following lists of data items :  
30, 20, 45, 75, 20, 25, 50, 15, 52, 35, 80, 55, 15, 40, 10 (CO4, K3) 10

8. Answer any one of the following:-

- 8-a. Briefly explain Indexed sequential access file organization. What is the difference between read and write mode of a file? (CO5,K2) 10
- 8-b. Find the single source shortest path using 10



dijkstra algorithm for the following graph having '1' as the Source vertex (CO5,K3)

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